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## International framework for red flags for potential serious spinal pathologies

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## International Framework for Red Flags for Potential Serious Spinal Pathologies

Identifying serious pathology as the cause of a person's musculoskeletal presentation is complex. Red flags have historically been used to help clinicians identify serious spinal pathology, and the majority of guidelines recommend the use of red flags. However, guidelines are not consistent about which red flags should be considered when examining people seeking care for musculoskeletal disorders. This has led to confusion and inconsistency in the management of people when there is suspicion of serious pathology, and, in some cases, to unnecessary and worrying medical tests or false reassurance that there is no serious pathology.

We aim to provide clinicians with a more standardized and consistent approach to identifying people with potential serious spinal pathology. This framework has been developed by researchers and clinicians to provide a pragmatic approach for clinicians to screen for serious spinal pathology that

can masquerade as musculoskeletal spinal conditions. The framework has been informed by available evidence and augmented by a formal consensus process that included academics and clinicians involved in the management of musculoskeletal conditions.

This framework aims to support a variety of health professionals, irrespective of experience, who provide care for people with musculoskeletal spinal conditions. Clinicians working in musculo-

skeletal services can play an important role in early identification of serious pathology, ensuring that people achieve the best possible outcome. The prevalence of serious pathology will vary depending on where in the clinical pathway the clinician has contact with the person. Spinal surgeons likely see more cases of serious pathology than general practitioners do, and physical therapists probably see a number in between, depending on where they are on their clinical pathway. Therapists working at an advanced-practice level are likely to see more serious pathology, as the populations they serve are likely to have more complex presentations.<sup>8,6</sup> Clinicians must consider the context within which red flags exist, and clinically reason the relevance of the information gathered to determine whether any action is required.

### Person-Centered Care

Working with people with possible serious pathology can be challenging, and a collaborative approach is essential. A possible diagnosis of serious pathology can be extremely worrying for people in regard to their families and careers. People must be involved in decision making

• **SYNOPSIS:** The International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) led the development of a framework to help clinicians assess and manage people who may have serious spinal pathology. While rare, serious spinal pathology can have devastating and life-changing or life-limiting consequences, and must be identified early and managed appropriately. Red flags (signs and symptoms that might raise suspicion of serious spinal pathology) have

historically been used by clinicians to identify serious spinal pathology. Currently, there is an absence of high-quality evidence for the diagnostic accuracy of most red flags. This framework is intended to provide a clinical-reasoning pathway to clarify the role of red flags. *J Orthop Sports Phys Ther* 2020;50(7):350-372. Epub 21 May 2020. doi:10.2519/jospt.2020.9971

• **KEY WORDS:** cauda equina syndrome, clinical reasoning, malignancy, spinal fracture, spinal infection

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about their care, even when faced with a serious diagnosis. Shared decision making is essential to ensure that individuals are supported to make decisions that are right for them. Using a collaborative process, the clinician should highlight the treatment options, evidence, risks, and benefits and, together with the person, seek to understand how these fit with that person's circumstances, goals, values, and beliefs.<sup>56</sup>

### Experts by Experience: How to Use This Framework

Clear and open communication with people with potential serious pathology is vital. People presenting with spinal pain may have no concept that their bladder or bowel function might be affected, or that the spinal pain could be caused by serious pathologies such as infection or malignancy. Providing the reason for the questions in the framework is an important aspect of the consultation, as some of these questions may seem irrelevant to a person who presents with back pain.

Effective communication about red flags is vital. People can become worried before an appointment, especially if they have seen something worrying on television or the internet, heard a story from a friend or relative, or experienced medical misdiagnosis.

Provide reassurance about why you are assessing for red flags, especially when the person is likely at low risk of having severe pathology. Consider the wording of your questions, your body language, tone of voice, and mannerisms when asking the questions.

People must feel at ease when answering questions and not judged (eg, intravenous drug use, poor social and environmental factors). Ensure people have sufficient time to consider and communicate their answers about something that they may never have considered before (eg, their toilet habits and how those may have changed).

Provide support regarding the emotional impact of being assessed for po-

tentially life-changing conditions and, in some cases, being sent for further investigations. When asking about subjects such as previous history of cancer, it is particularly important to offer appropriate emotional support and, when needed, help people find other services that can offer further support.

### How an International Framework Can Help Clinicians

This is an internationally agreed-on framework to aid early assessment and initial management of people who present with potential serious spinal pathology. These conditions, while considered rare, can lead to devastating and life-changing/life-limiting consequences for people. The neurological function and quality of life of people with metastatic spinal cord compression (MSCC) can be preserved with early diagnosis, by facilitating rapid access to appropriate treatment, reduction in nerve damage, and maintenance of spinal stability.<sup>32</sup> Substantial litigation costs can be incurred by health care providers if serious spinal pathology is not identified early and managed appropriately. Litigation relating to cauda equina syndrome (CES) alone accounted for £25 million (\$40 million) in claims against the National Health Service in the United Kingdom from 2010 to 2015.<sup>54</sup>

This international framework has been developed on behalf of the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT)

and has been coordinated by researchers at Manchester Metropolitan University. Due to a paucity of primary evidence, the framework has been developed by expert clinicians' interpretation of the highest-quality evidence available.

### Key Term: Red Flags

Red flags are signs and symptoms that raise suspicion of serious spinal pathology. Until now, there has been little guidance on their use and they have been left to individual interpretation. For spinal pathology, 163 signs and symptoms have been reported as red flags,<sup>32</sup> including 119 symptoms from the individual's history and 44 signs from the physical examination.

The high number of red flags presents a challenge in terms of their everyday practical utility. Few red flags, when used in isolation, are informative. Red flags used in combination have promise,<sup>35</sup> but further validation studies are required. There is a lack of high-quality evidence for the diagnostic accuracy of red flag tests,<sup>20,34</sup> and the evidence supports only a limited number of red flags to raise suspicion of serious pathology. There is no consensus on which red flags are most useful to identify serious spinal pathology or how they should be used in the clinical setting.<sup>82</sup>

Despite the problems, red flag tests remain the best tools that health care practitioners have to raise suspicion of serious spinal pathology when used in combination with a thorough patient

### Key Clinical Messages

- There is a lack of evidence to support the informativeness of the majority of red flags commonly used in clinical practice.
- Few red flags, when used in isolation, are informative. Combinations of red flags demonstrate promise, but this work requires further validation.
- Red flags remain the best tools at the clinician's disposal to raise suspicion of serious spinal pathology, when used within the context of a thorough subjective patient history and physical examination.
- Clinicians should consider both the evidence to support red flags and the individual profile of the person's determinants of health (eg, age, sex) to decide the level of concern (index of suspicion) for presence of serious spinal pathology.

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history and an appropriate physical examination. Serious spinal pathology is associated with increasing age, although serious pathology can affect all ages.<sup>33</sup> Populations around the world are aging, which presents challenges, as people with increased medical complexity and morbidities present more often to musculoskeletal services. Consequently, therapists may see more patients with serious pathology.

## Goal of the International Framework

Given the paucity of high-quality evidence to guide practice, we built this framework on multiple perspectives, including synthesizing the current research data, expert consensus and opinion, and steering-group consensus, to reflect an evidence-based practice approach.<sup>77</sup> The framework is intended to provide clinicians with a clear clinical-reasoning pathway to clarify the role of red flags in identifying serious spinal pathology.

## Decision Tool for Early Identification of Serious Spinal Pathology

The basis of our framework is a decision tool to help clinicians identify serious spinal pathology. The tool has 3 steps:

1. Determine your level of concern. Consider the evidence to support red flags and the individual profile of the person's health determinants (eg, age, sex) to decide your level of concern (your index of suspicion) about the presence of serious pathology (**FIGURE 1**).
2. Decide on your clinical action, based on your level of concern determined in step 1 (**FIGURE 2**).
3. Consider the pathway for emergency/urgent referral. Know your local referral pathways and pathways to access specialist care if indicated (**FIGURE 3**).

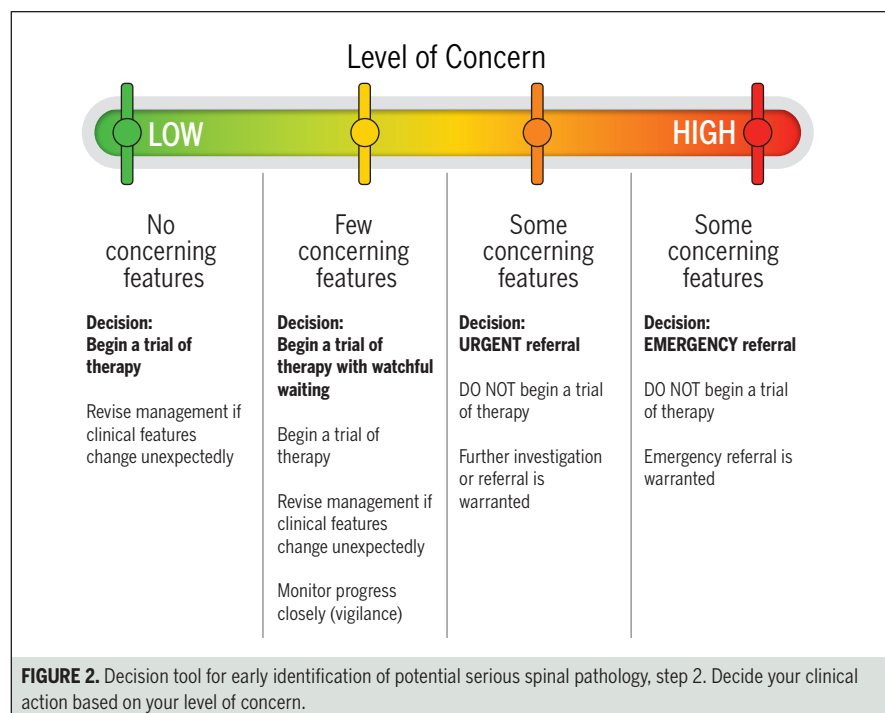
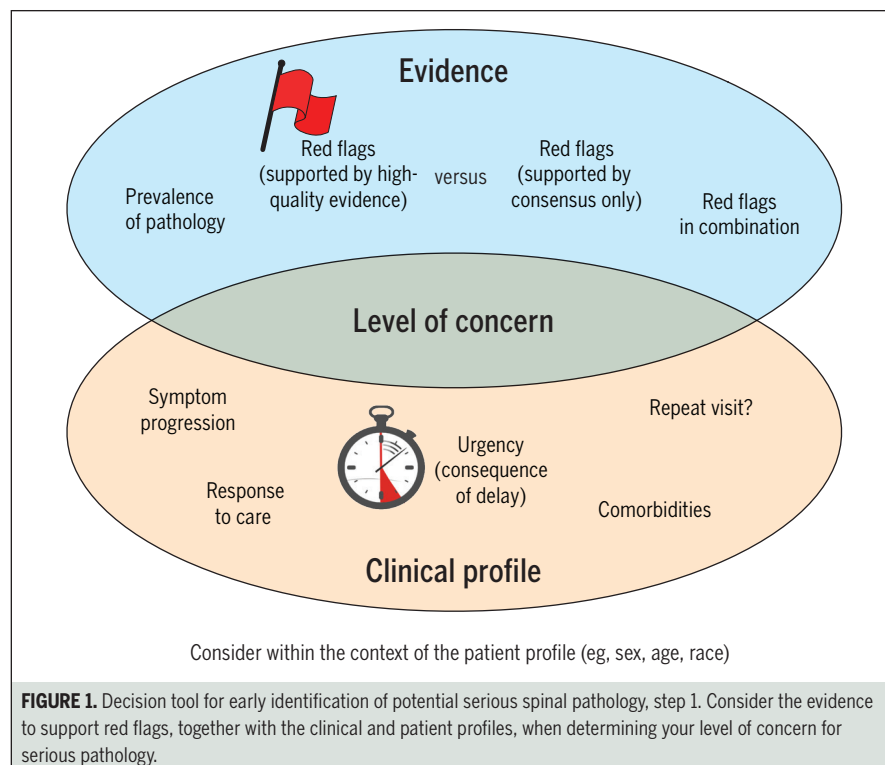
## Prioritize Serious Spinal Pathologies

In 2016, the member organizations of IFOMPT, a subgroup of the World Confederation for Physical Therapy, identified 4 priority areas for discussion and research on red flags (incidence data presented in

**TABLE 1):** CES, spinal fracture, malignancy, and spinal infection.

The following sections summarize the red flags for each of the 4 prioritized se-

rious spinal pathologies and outline risk factors, symptoms, signs, and initial investigations. Each section concludes with a series of clinical-reasoning scenarios.



(For all the key definitions used in this document, see **APPENDIX A**, available at [www.jospt.org](http://www.jospt.org)).

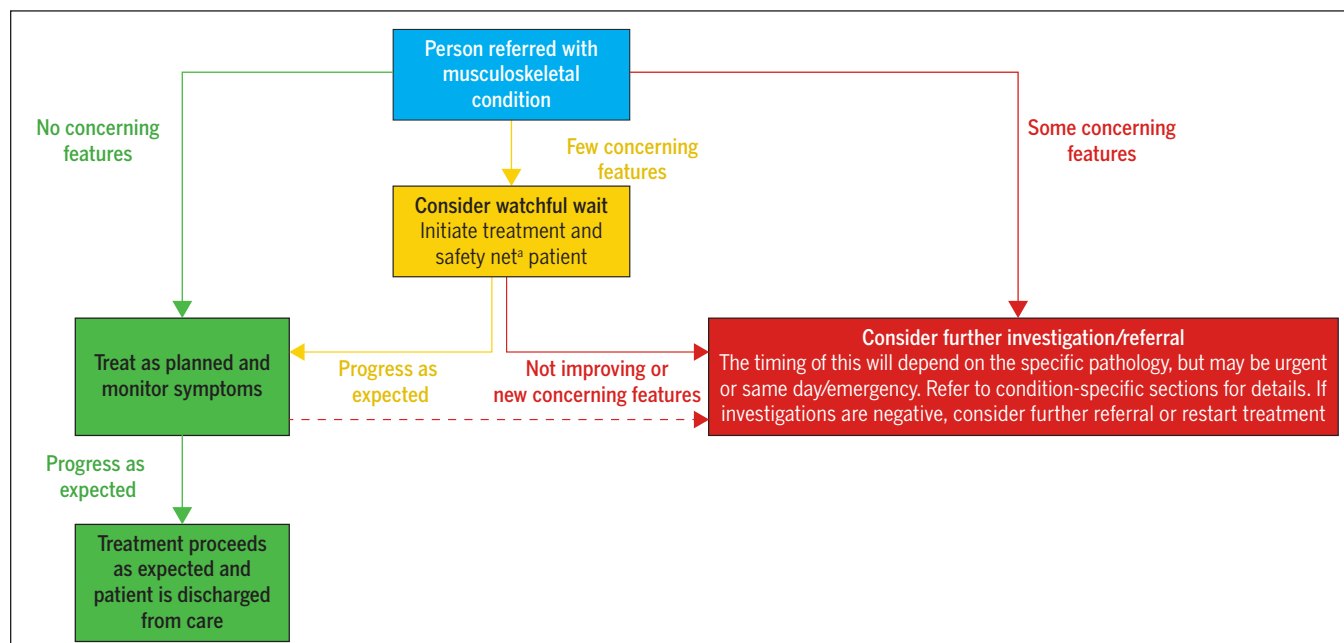
### Method: Haute Autorité de Santé Consensus Method

This framework combines an evidence synthesis and international expert consensus. We followed the Haute Autorité de Santé recommendations for the devel-

opment of clinical guidelines.<sup>3</sup>

**Phase 1** We reviewed systematic reviews and other key papers summarizing available evidence related to red flags in 1 or more of the 4 key spinal pathologies (see **APPENDIX B**, available at [www.jospt.org](http://www.jospt.org), for an evidence summary table). This led to the formulation of 4 international expert consensus questionnaires, 1 for each key pathology.

**Phase 2** Jisc Online Surveys (Jisc, Bristol, UK) was used to administer the 4 separate questionnaires developed in phase 1. The international expert group (100 experts from 19 countries) rated red flag statements based on the evidence presented (phase 1) and their own experience. Each section reports separately on how many experts were involved in the consensus process for that section. Ano-



**FIGURE 3.** Decision tool for early identification of potential serious spinal pathology, step 3. Consider the pathway for emergency/urgent referral if indicated. \*Safety netting is a management strategy used for people who may present with possible serious pathology. These strategies should include advice on which signs and symptoms to look out for, which action to take if symptoms deteriorate, and the time frame within which action should be taken.<sup>37</sup>

**TABLE 1**

### PREVALENCE ESTIMATES FOR KEY PATHOLOGIES WHEN PRESENTING WITH BACK PAIN<sup>a</sup>

	Primary Care	Secondary Care	Tertiary Care: ED	Tertiary Care: Spine Center
CES	Estimated incidence (UK): 0.002% <sup>31</sup> Back pain: 0.04% <sup>17</sup>			LBP: 0.4% <sup>66</sup>
Fracture: OCF	LBP: 0.7%, <sup>35</sup> 3.0%, <sup>73</sup> 4.0%, <sup>41</sup> 4.1%, <sup>80</sup> 4.5% <sup>15</sup>	Left X-ray: 2.6% <sup>69</sup>	Back pain: 6.5% <sup>29</sup> Left X-ray: 7.3%, <sup>65</sup> 11.0% <sup>68</sup>	LBP: 5.6% <sup>66</sup>
Fracture: traumatic	LBP: <1% <sup>41</sup>			
Malignancy	LBP: 0.0%, <sup>35</sup> 0.1%, <sup>19</sup> 0.2%, <sup>43</sup> 0.2%, <sup>26</sup> 0.6%, <sup>16</sup> 0.7% <sup>15</sup> Nonmechanical pain: 0.7% <sup>41</sup>	Musculoskeletal pain: 7.0% <sup>40</sup>	LBP: 0.1% <sup>68</sup>	LBP: 1.6% <sup>66</sup> Lumbar restriction: 6.0% <sup>13</sup>
Infection <sup>b</sup>	Nonmechanical LBP: 0.01% <sup>41</sup>			LBP: 1.2% <sup>66</sup> Postprocedural discitis represents up to 30% of all cases of pyogenic spondylodiscitis <sup>21</sup>

Abbreviations: CES, cauda equina syndrome; ED, emergency department; LBP, low back pain; OCF, osteoporotic compression fracture.

<sup>a</sup>Values are estimated point prevalence or incidence (where indicated).

<sup>b</sup>Infective spondylitis in all settings: 0.0004%<sup>21</sup> (in developed countries).



nymized responses were returned online using a rating scale between 1 and 9 (1 being totally inappropriate, 9 being totally appropriate). All results were reviewed by the steering committee.

We calculated the median score for each statement. Statements with a median score of 7 or above were classed as consensus appropriate, and those with a median score of 3.5 or less were classed as consensus inappropriate.<sup>3</sup> Any remaining items that had not gained consensus by this point were reviewed by the steering committee, and a consensus decision was then taken to either include or exclude these items in the draft framework.

**Phase 3** The draft framework was developed by the steering group based on a synthesis of the results from phases 1 and 2.

**Phase 4** The draft framework was presented to an international peer-review group (70 individuals) for opinion on the content, independent of the people taking part in phase 2. The international peer-review group was invited to rate the content via an online questionnaire. The review group rated each section of the framework based on the following criteria:

- Applicability: relevance to the clinical practice
- Acceptability: clinical usefulness or helpfulness
- Readability: ease of reading

They were also able to offer suggestions on changes/improvements. This peer-review group included chiropractors, osteopaths, physical therapists, experts by experience, and member organization delegates of the IFOMPT. The response rate of 41% included individuals from 13 countries. The median score for each section was calculated. All sections gained a median score of 7 or above and were therefore classed as appropriate according to the Haute Autorité de Santé method. All comments were reviewed by the steering committee and relevant changes made to the framework.

**Phase 5** Based on the phase 4 feedback,

the steering group developed the final version of the clinical framework.

## Cauda Equina Syndrome

The cauda equina comprises 20 nerve roots that originate from the conus medullaris at the base of the spinal cord. Cauda equina syndrome occurs as a result of compression of these neural structures. Cauda equina syndrome is challenging to diagnose and manage in a timely manner. It may present in any clinical setting, and clinicians must effectively and efficiently reason through their findings to provide timely management. Timely diagnosis is essential to avoid life-changing outcomes such as ongoing bladder, bowel, and sexual dysfunction, along with psychosocial consequences.<sup>31</sup>

**Literature and International Consensus** Three key source papers were used to formulate the international consensus questionnaire for this section on CES<sup>18,28,31</sup> (**APPENDIX B**). The questionnaire was sent to 23 international experts and contained 25 items (**TABLES 2** through **6**).

**Epidemiology** The incidence of CES in the United Kingdom has been estimated to be 0.002%.<sup>31</sup> The overall prevalence of CES has been estimated to range from 1 in 33 000 to 1 in 100 000 persons.<sup>48</sup> Point prevalence of CES as a cause of low back pain (LBP) is estimated at 0.04% in primary care<sup>17</sup> and 0.4% in tertiary care.<sup>66</sup> Cauda equina syndrome is a complication of approximately 2% of all herniated discs.<sup>18</sup> The incidence of postoperative CES is estimated to be between 0.08% and 0.2%.<sup>42</sup>

Twenty-three percent of litigation claims for spinal surgery in England relate to CES, according to an assessment of litigation claims in England between 2013-2015 and 2015-2016.<sup>39</sup>

**Risk Factors** Compression of the cauda equina usually occurs as a result of a disc prolapse.<sup>18</sup> However, any space-occupying lesion could cause cauda equina compression. Relevant symptoms that can be precursors to CES are unilateral or bilateral radicular pain, dermatomal reduced sensation, and myotomal weakness.

If symptoms progress from the precursors described above, with any suggestion of changes in bladder or bowel function or saddle sensory disturbance, then suspect CES. Clinical cue cards and credit card-size patient information handouts can aid communicating sensitive, sometimes subtle but important symptoms,<sup>22</sup> and should form the basis of your questioning.

**Clinical Picture** If you suspect CES, perform a full neurological assessment to establish dermatome sensory loss, myotome weakness, or reflex changes.<sup>28</sup> A digital rectal examination is no longer considered essential in a primary care setting in the United Kingdom. It is necessary in secondary care to evaluate loss of anal sphincter tone. Sensation to light touch and pinprick throughout the saddle region, including the buttocks, inner thighs, and perianal region, is a necessary test in any clinical situation. These intimate objective tests must only be performed by an appropriately trained clinician, with a chaperone for the benefit of both the person and the

TABLE 2

## NUMBER OF CAUDA EQUINA SYNDROME RED FLAGS GAINING CONSENSUS

Number of Red Flags	
Questionnaire sent to 23 international experts	25 items reviewed <ul style="list-style-type: none"> <li>• 18 items reached consensus as appropriate</li> <li>• 2 items reached consensus as inappropriate</li> <li>• 5 items had no consensus</li> </ul>
Steering committee reviewed results	20 items included in the framework ( <b>TABLES 3</b> through <b>6</b> ) (2 items combined) 4 items excluded ( <b>APPENDIX C</b> )

clinician. Conduct the assessment while considering cultural sensitivities, local pathways, medicolegal frameworks, and state regulations.

People should be sent for emergency magnetic resonance imaging (MRI) and surgical opinion. Positive findings are likely to be accompanied by an ul-

trasound of the bladder. It is important to know your local care pathway so that people are managed appropriately. When a person does not currently have CES but there is a suspicion that he or she may later develop CES, it is essential that the person is "safety netted" (ie, informed about what to look out

for and what to do if symptoms of CES develop).

## CES Clinical-Reasoning Scenarios

### Case 1

A woman is urgently referred to you with back pain. Within the wider detailed subjective and objective examination, there

TABLE 3

## RISK FACTORS FOR CAUDA EQUINA SYNDROME

Risk Factor/Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Herniated intervertebral disc Low	The most common cause arises from a large central disc herniation at the L4-5 or L5-S1 level <sup>61</sup>  Those under 50 y of age carry a higher risk, as do obese people  Relevant symptoms that can be a precursor to CES: <ul style="list-style-type: none"> <li>• Unilateral or bilateral radicular pain and/or</li> <li>• Dermatomal reduced sensation and/or</li> <li>• Myotomal weakness<sup>11</sup></li> </ul>	How old are you? Do you have any leg pain? Where exactly is the pain in your legs (above or below knees)? Is the pain down both legs at the same time?  Do you have any pins and needles or numbness in your legs, inner thighs, bottom, or genitals? Do you feel any weakness in your legs?	No leg pain, normal neurology, and no CES symptoms	<ul style="list-style-type: none"> <li>• Unilateral or bilateral radicular pain and/or dermatomal reduced sensation and/or myotomal weakness</li> <li>• Reduced saddle sensation (subjective or objective pinprick)</li> <li>• Bladder disturbance</li> <li>• Bowel disturbance</li> <li>• Reduced anal tone/absent squeeze</li> <li>• Sexual disturbance<sup>31</sup></li> </ul> Presentations that increase the probability of acute threatened CES: <ul style="list-style-type: none"> <li>• Back pain with <ul style="list-style-type: none"> <li>- Presence of new saddle anesthesia, bladder or bowel disturbance</li> <li>- Age, &lt;50 y</li> <li>- Unilateral onset progressing to bilateral leg pain</li> <li>- Alternating leg pain</li> <li>- Presence of new motor weakness</li> </ul> </li> </ul>
LSS Low	The degenerative changes in the lumbar spine that are responsible for LSS have the potential to lead to a gradual compromise of the cauda equina nerve roots. This can result in slow-onset CES being overlooked or dismissed in older people <sup>11</sup>  CES symptoms associated with degenerative LSS are generally much less clear than with a herniated disc or claudication. A range of typical leg symptoms (eg, aching, cramping, tingling, and heaviness) provoked by walking and eased by sitting should be considered as important in LSS <sup>27</sup>	Can you describe any worsening symptoms, including your level of pain or symptoms in your legs?  If 0 is no pain and 10 is the worst pain you have ever had, how low does the pain go?  How high does the pain go? What makes it worse? What makes it better?	Stable or no neuropathic leg symptoms	Recurring and insidious but increasing back pain, with gradual onset of unilateral or bilateral lower-limb sensory disturbance and/or motor weakness  Incomplete bladder emptying, urinary hesitancy, incontinence, nocturia, or urinary tract infections. Bladder and/or bowel dysfunction may progress gradually over time <sup>11</sup>
Spinal surgery Low	CES is a risk with any lumbar spine surgical intervention	...	NA	Nerve injuries and paralysis can be caused by a number of problems, including <ul style="list-style-type: none"> <li>• Bleeding inside the spinal column (extradural spinal hematoma)</li> <li>• Leaking of spinal fluid (incidental durotomy)</li> <li>• Accidental damage to the blood vessels that supply the spinal cord with blood</li> <li>• Accidental damage to the nerves when they're moved during surgery<sup>65</sup></li> </ul>

Abbreviations: CES, cauda equina syndrome; LSS, lumbar spinal stenosis; NA, not applicable.

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TABLE 4

## SYMPTOMS OF CAUDA EQUINA SYNDROME

Symptoms (subjective)/ Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Sensory change (lower limbs) Low	History of symptoms, pattern, progression, and time scale Consider existing comorbidities (eg, multiple sclerosis, diabetes)	When did the sensation problems in your leg(s) start? Where did they begin and how did those symptoms change as time went on? Exactly where in your legs do you feel the symptoms? Do you have any other medical conditions?	Normal neurology	Sensory change (lower limbs)
Motor weakness (lower limbs) Low	Time scales of perceived weakness and progression are important to establish Consider existing comorbidities (eg, aortic aneurysm)	When did the weakness problems in your leg(s) start? Where did the weakness begin and how did those symptoms change as time went on? Do you have any other medical conditions?	As above	Motor weakness (lower limbs)
Saddle sensory disturbance Low	Precise extent of pins and needles and/or numbness (eg, difference between bicycle/horse saddle) Previous history Trauma/surgery Other potential pudendal nerve compression (eg, cycling)	See CES cue card Exactly where do you feel the numbness in your bottom, inner thighs, or genitals? Where did it start and how has the numbness and/or pins and needles changed over time? Do you have normal sensation when you wipe after toileting? How long has this been present? What hobbies do you have? Were any interventions used during childbirth? (where appropriate) Have you had any previous surgery?	NA	Saddle sensory disturbance
Change in ability to achieve an erection or ejaculate Low	History of symptoms, progression, and time scale Side effects from pharmacology (neuropathic medications, codeine) Age: older people may have spinal stenosis and are less likely to have acute CES Functional symptoms: psychosocial presentation and health care utilization	See CES cue card When did these symptoms begin? If it was some time ago, are these symptoms different? Do you have any other medical conditions? Have you started any new medication? Were the symptoms present before you began this medication or after? Routine questions related to psychosocial distress	NA	Recent change in ability to achieve an erection or ejaculate
Loss of sensation in genitals during sexual intercourse Low	Previous history of sexual dysfunction? Is this different?	See CES cue card for relevant questions that need to be asked, including the following: • When did these symptoms begin? • If it was some time ago, are these symptoms different? • Do you have any other medical conditions? Ask routine questions related to psychosocial distress	NA	Loss of sensation in genitals during sexual intercourse
Urinary function (eg, frequency) Low	Previous history of bladder disturbance Establish precise change in function, such as hesitancy, change in stream, loss of sensation passing urine, inability to feel when the bladder is full or empty, and sensation of incomplete voiding	See CES cue card for relevant questions that need to be asked, including the following: • When did the changes begin? • Describe the changes in urine function • Do you have any other medical conditions? • Have you started any new medication? • Were the symptoms present before you began this medication or after?	NA	Urinary function (eg, frequency)
Urinary retention Low	Previous history of bladder disturbance Most of these people will not have critical cauda equina compression. However, in the absence of reliably predictive symptoms and signs, there should be a low threshold for investigation with an emergency MRI scan <sup>28</sup> Age: older people may have spinal stenosis and are less likely to have acute CES Functional symptoms: psychosocial presentation and health care utilization Be aware of an increase in health-seeking behavior	See CES cue card for relevant questions that need to be asked, including the following: • When did the changes begin? • When did you last pass urine? • Have you started any new medication? • Were the symptoms present before you began this medication or after? • Do you have any other medical conditions? • Have you attended any other health care setting (GP, surgery, clinic, hospital, etc) because of this problem? - If so, who did you see and when?	NA	Urinary retention

Table continues on page 357



TABLE 4

## SYMPTOMS OF CAUDA EQUINA SYNDROME (CONTINUED)

Symptoms (subjective)/ Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Urinary incontinence Low	Previous history of bladder disturbance	See CES cue card for relevant questions that need to be asked, including the following: <ul style="list-style-type: none"> <li>• When did the changes begin?</li> <li>• When did you last pass urine?</li> <li>• Have you started any new medication?</li> <li>• Were the symptoms present before you began this medication or after?</li> <li>• Do you have any other medical conditions?</li> <li>• Have you attended any other health care setting (GP, surgery, clinic, hospital, etc) because of this problem? <ul style="list-style-type: none"> <li>- If so, who did you see and when?</li> </ul> </li> </ul>	NA	Urinary incontinence
Bowel incontinence Low	Previous history of bowel disturbance	See CES cue card for relevant questions that need to be asked, including the following: <ul style="list-style-type: none"> <li>• When did the changes begin?</li> <li>• When did you last open your bowels?</li> <li>• Have you started any new medication?</li> <li>• Were the symptoms present before you began this medication or after?</li> <li>• Do you have any other medical conditions?</li> <li>• Have you attended any other health care setting (GP, surgery, clinic, hospital, etc) because of this problem? <ul style="list-style-type: none"> <li>- If so, who did you see and when?</li> </ul> </li> </ul>	NA	Bowel incontinence
Constipation Low	Previous history of bowel disturbance History of symptoms and time scale Side effects from pharmacology (neuropathic medications, codeine) Age: older people may have spinal stenosis and are less likely to have acute CES Functional symptoms: psychosocial presentation and health care utilization	See CES cue card When did the changes begin? When did you last pass a stool? Have you started any new medication? Were the symptoms present before you began this medication or after? Do you have any other medical conditions? Have you attended any other health care setting (GP, surgery, clinic, hospital, etc) because of this problem? • If so, who did you see and when?	...	Constipation
Unilateral/bilateral leg pain Low	Unilateral radicular leg pain progressing to bilateral radicular leg pain is a concerning presentation The prevalence of bilateral leg pain in primary care is not known Consider other causes of leg pain: <ul style="list-style-type: none"> <li>• Smoker</li> <li>• Cardiovascular disease</li> </ul> Lesion higher in the spine	When did the pain progress from 1 leg to 2? How far down each leg does the pain go? Do you have any conditions that affect your heart or circulation?	No CES symptoms	Unilateral/bilateral leg pain
Low back pain Low	Presentations that increase the probability of acute threatened cauda equina Back pain with: <ul style="list-style-type: none"> <li>• Presence of new saddle anesthesia, bladder or bowel disturbance</li> <li>• Age, &lt;50 y</li> <li>• Unilateral onset progressing to bilateral leg pain</li> <li>• Alternating leg pain</li> <li>• Presence of new motor weakness</li> <li>• Obesity</li> </ul> History of symptoms and time scale	When did your back pain begin? How has it progressed? Do you have or have you had leg symptoms? <ul style="list-style-type: none"> <li>• If so, where exactly is your leg pain?</li> </ul> Consider questions on CES cue card if symptoms progress	See context	Low back pain

Abbreviations: CES, cauda equina syndrome; GP, general practitioner; MRI, magnetic resonance imaging; NA, not applicable.

# POSITION STATEMENT

TABLE 5

SIGNS OF CAUDA EQUINA SYNDROME

Signs (objective)/ Level of Evidence	Context	Physical Assessment	Low Clinical Suspicion	High Clinical Suspicion
Sensory deficit in saddle to light touch and pinprick Low	Examination in any clinical setting, but only if CES is suspected from the history Normal examination findings do not exclude the possibility of CES Consider previous trauma/surgery to perineum	Objective light touch and pinprick carried out by a suitably trained clinician with a chaperone present	NA	NA
Abnormal lower-limb neurology Low	Establish time frame of progression of neurology Other causes (eg, upper motor condition, peripheral neuropathy)	Myotomes, dermatomes, and reflexes Consider tone, proprioception, and clonus	Normal neurology	Abnormal and progressing neurological deficit Management depends on the degree of neurological deficit: if there is gross motor weakness (<3/5) or deteriorating neurology
Reduced anal tone Low	Examination in a secondary care setting, but only if CES is suspected from the history Normal examination findings would not exclude the possibility of CES Consider previous trauma/surgery to perineum	Digital rectal examination should be carried out by a suitably trained clinician with a chaperone present	NA	NA

Abbreviations: CES, cauda equina syndrome; NA, not applicable.

TABLE 6

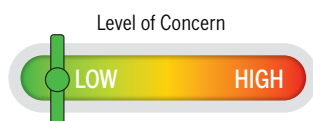
INITIAL INVESTIGATIONS FOR CAUDA EQUINA SYNDROME

Modality	Context
MRI	MRI is the gold standard investigation to confirm the diagnosis of CES Most guidelines recommend that people presenting with any of these key clinical signs and symptoms be referred urgently <sup>18</sup>
CT scan	If there are contraindications to MRI

Abbreviations: CES, cauda equina syndrome; CT, computed tomography; MRI, magnetic resonance imaging.

are no positive items on the CES cue card.

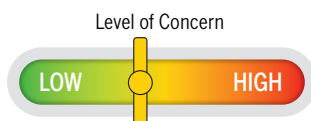
- LBP, no leg pain
- No symptoms of CES
- Clinical action: begin a trial of therapy



## Case 2

The woman has back and leg pain. The pain in her leg is getting worse and is now radiating distally below the knee, and she has started to notice pain in the other leg. Nothing on CES questioning is positive, and there is no existing neurological deficit.

- Leg pain worsening
- Signs of bilateral leg pain
- Clinical action: safety net. The important thing in this case is to discuss and document a clear strategy to follow if symptoms deteriorate (safety net), ensuring the person is aware that she needs to act immediately if things get worse

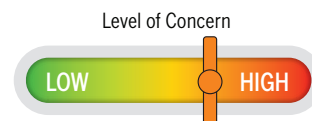


## Case 3

The woman now has back and increasing leg pain bilaterally. She reports one episode of incontinence 4 weeks ago, but

not since. Neurological examination is unremarkable.

- Back and bilateral leg pain increasing
- One episode of incontinence 4 weeks ago
- Clinical action: urgent MRI and discuss and document a clear strategy to follow if symptoms deteriorate (safety net)

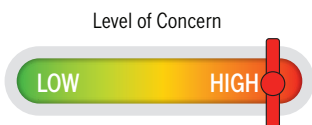


## Case 4

The woman has now developed a 1-week history of some numbness of the left side of the vagina.

- Back and bilateral leg pain increasing

- One episode of incontinence 4 weeks ago
- One-week history of vaginal numbness
- Clinical action: emergency MRI/refer onto emergency pathway



**Suggested Pathway for Emergency/Urgent Referral** Refer to the clinical decision tool for suggested pathways for emergency/urgent referral (**FIGURE 3**).

### Spinal Fracture

Spinal fractures make up the largest number of serious pathologies in the spine. While these are predominantly a risk for older patients, especially women, clinicians need to be aware of the risk factors and signs and symptoms of spinal fractures and to consider what detailed questions to ask to help with further management.

Five key source papers were used to formulate the international consensus questionnaire for spinal fracture<sup>23,50,63,72,85</sup> (**APPENDIX B**). The questionnaire was sent to 28 international experts and contained 27 items (**TABLES 7** through **11**).

**Epidemiology** Estimates for the point prevalence of osteoporotic compression fracture as a cause of LBP range between 0.7% and 4.5% in the primary care setting<sup>16,35,41,73,80</sup> and 6.5% in the emergency care setting.<sup>29</sup> Low-impact or nontraumatic fractures are the most common serious pathology in the spine, with vertebral fractures being the most common osteoporotic fracture. Approximately 12% of women between 50 and 70 years of age and up to 20% of those over 70 years of age have vertebral fractures.<sup>72</sup> As much as 70% of these fractures are undiagnosed and found during investigation for other health conditions.<sup>50</sup>

It is important to identify people with vertebral fractures, as they are more likely to sustain later hip fractures, bringing further health consequences and risk for the person. Red flags purported to indi-

cate possible fracture are unhelpful in diagnosing vertebral fracture, with many false-positive tests accompanied by low diagnostic accuracy.<sup>85</sup> Acting on single red flags is not recommended. Instead, consider broader risk factors and differential diagnoses.<sup>85</sup> Osteoporotic fractures have a similar distribution as metastases, with 70% in the thoracic region, 20% in the lumbar region, and 10% in the cervical region. Most spinal fractures occur between the T8 and L4 levels.<sup>64</sup>

**Risk Factors** An increasing number of younger people are affected by insufficiency spinal fractures (fractures caused by normal stresses on weakened bone), due to a range of risk factors. These include excessive alcohol consumption (risk increases when drinking greater than 3 units per day), vitamin D deficiency, long-term corticosteroid use (greater than 5 or 7.5 mg per day over a 3-month period), rheumatoid arthritis, diabetes, smoking (greater than 20 cigarettes per day<sup>61</sup>), dietary restriction, eating disorders, and absorption problems from the gut (eg, Crohn's disease<sup>5,75</sup>). Establish the presence or absence of these risk factors with detailed history taking.

**Clinical Picture** People commonly present with sudden onset of pain, mostly located in the thoracolumbar region, following low-impact trauma such as a slip or trip or lifting something while in a flexed position. The pain varies in presentation, but is often severe and mostly localized to the area of the fracture.<sup>36</sup> Weight-bearing activities and active movements are restricted and painful, and the person may require strong analgesia, particularly in

the early stages. On physical examination, the person may have an increased prominence of the spinous process at the affected level, and increased kyphosis. The person may be tender to percussion at the affected level, though absence of this should not reassure the clinician that there is no fracture.<sup>50</sup> People with a suspected fracture should have an X-ray in the first instance to determine whether a fracture is present, and to grade and define the nature of the fracture.

**Differential Diagnosis** Consider possible differential diagnoses for spinal fracture. These include metastatic spinal disease (see the Spinal Malignancy section) and multiple myeloma, both of which can cause healthy bone to be replaced by tumor. In the case of metastatic disease, 60% of metastases occur in the anterior half of the vertebral body, thus potentially weakening this area and leading to a wedge fracture. These fractures may look very similar on X-ray. Take a careful history and explore any relevant risk factors for each type of pathology.

Fractures from myeloma may also look very similar to osteoporotic fractures on X-ray, depending on the location. People with myeloma may present at a slightly earlier age than those with osteoporosis and metastases, but further imaging may be required to establish the cause of a fracture if there are no clear indications from the person's subjective history.

### Clinical-Reasoning Scenarios

#### Case 1

A 35-year-old man presents with sudden onset of thoracic pain after lifting a heavy

**TABLE 7**

#### NUMBER OF SPINAL FRACTURE RED FLAGS GAINING CONSENSUS

Number of Red Flags	
Questionnaire was sent to 28 international experts	27 items reviewed <ul style="list-style-type: none"> <li>• 13 items reached consensus as appropriate</li> <li>• 14 items had no consensus</li> <li>• 0 items reached consensus as inappropriate</li> </ul>
Steering committee reviewed results	18 items included in framework ( <b>TABLES 8</b> through <b>11</b> ) 9 items excluded ( <b>APPENDIX C</b> )

# POSITION STATEMENT

TABLE 8

RISK FACTORS FOR SPINAL FRACTURE

Risk Factor/Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
History of osteoporosis High	History of osteoporosis increases the risk of fracture A family history of osteoporosis will also increase the risk of osteoporosis and fracture in women <sup>36</sup> People with known osteoporosis have an increased risk of fracture, and those with a previous osteoporotic fracture have a 5.4-fold increased risk of vertebral fracture and a 2.8-fold increased risk of hip fracture <sup>75</sup> Medication for osteoporosis can reduce the risk of fracture in the following year by 50% to 80% <sup>72</sup>	Do you have osteoporosis? Do you have a family history of osteoporosis? Have you had previous osteoporotic fractures? Are you taking any medication for your osteoporosis? • If so, what are you taking? • If not, have you been prescribed it, or is there a reason you are not taking it?	No family history No other osteoporotic risk factors No previous fractures	Previous osteoporotic fractures Concurrent osteoporotic risk factors
Corticosteroid use High	Steroid use of 7.5 mg for >3 mo increases the risk of osteoporosis. <sup>12,58</sup> The effects of inhaled steroids are inconclusive in terms of bone mineral density, though the clinician should ask about high-dose inhaled steroid use <sup>75</sup>	Have you used steroid tablets or inhaled steroids? • How long have you used them for, and what dose did you use?	No steroid use Steroid use of <5 mg over a 3-mo period in a year	Steroid use of >5 mg over a 3-mo period
Previous history of cancer Low	Metastatic bone disease may decrease bone density, especially in the thoracic region (70% of cases)	Do you have a history of cancer? • Where was the cancer? • What treatment did you have for your cancer? • What stage was the cancer?	No past medical history of cancer	History of cancer of the • breast • prostate • lung • kidney • thyroid
Severe trauma High	The more significant the amount of trauma, the higher the likelihood of bony injury (ACR guidelines suggest a fall of 5 stairs or 3 ft) <sup>1</sup> The position of the person at the time of injury is also important (eg, flexed, as this might precipitate a fracture with a seemingly innocuous activity like coughing)	Have you had a significant injury/fall from a height? Did your pain start suddenly after a particular activity, like coughing or sneezing?	No immediate bony pain post injury	Immediate spinal pain post injury Focal bony tenderness in the midline of the spine may indicate underlying bony injury
Female sex High	19.8/1000 women have osteoporotic fracture 8.4/1000 men have osteoporotic fracture <sup>75</sup> Women with late-onset menarche (>16 y) <sup>70</sup> or early menopause (<45 y) are at higher risk of osteoporosis, <sup>81</sup> and therefore spinal fracture	How old were you when you started your periods? How old were you when you went through menopause?	Women with normal menarche and normal menopause with no other risk factors	Women who are postmenopausal, especially those with early menopause or those with late menarche
Older age High	Bone density decreases with age in women and men 12% of women aged 50-70 y have had a spinal fracture, and 20% of women over 70 y have had a spinal fracture 70% of these will not know about it <sup>72</sup>	Have you had any investigations for your bones, such as X-rays or DEXA scans?	People under 50 y	Women over 65 y and men over 75 y have a higher risk of vertebral fracture <sup>75</sup> Patients over 80 y have a very high likelihood of having had an osteoporotic fracture
Previous spinal fracture High	If previous fracture due to osteoporosis occurred, then the person has a 5.4-fold increased risk of vertebral fracture and a 2.8-fold increased risk of hip fracture within the year <sup>53,75</sup>	Have you had a previous spinal fracture?	No previous history of spinal fracture	Previous history of low-impact spinal fracture
History of falls Low	While the trauma of a fall may precipitate a fracture, multiple conditions can cause falls and immobility, especially in the older patient Parkinson's disease, multiple sclerosis, dementia, alcoholism, and malnutrition can all increase the risk of falls <sup>61</sup>	All people with osteoporosis should be assessed for risk of falls <sup>88</sup> All people should have a detailed past medical history taken	People with no comorbidities	People with comorbidities: the more they have, the higher risk they have of falling

Abbreviations: ACR, American College of Rheumatology; DEXA, dual-energy X-ray absorptiometry.

TABLE 9

## SYMPTOMS OF SPINAL FRACTURE

Symptoms (subjective)/ Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Thoracic pain High	Most (70%) nontraumatic spinal fractures occur in the thoracic spine. 70% of metastases occur in the thoracic spine, too, and should be considered in the differential diagnosis Myeloma most commonly affects the thoracic spine, too, and should also be considered in the differential diagnosis Band-like pain should be considered a concern and may indicate MSCC <sup>79</sup>	Detailed questioning of the patient is needed to assess for risk factors for each of these diseases	Thoracic pain with no history of cancer, osteoporosis, or myeloma and no further risk factors	Any patient with known cancer, myeloma, or osteoporosis
Severe pain Low	Some people may have a long history of back pain. It is important to establish whether this is a new or different pain	Is this a familiar pain to you/does this feel familiar? Have you experienced back pain in the past?	If this is a person's first episode of back pain, then conservative management is the first course of action	Describes pain that is unfamiliar and possibly worsening pain
Neurological symptoms Low	People with spinal fracture will not usually develop neurological deficit/signs, but must be carefully examined to exclude neurological deficit	Do you have any change in sensation in your arms or legs? Do you have any difficulties with walking or coordination? Do you have any difficulties with your balance?	No distally referred symptoms or subjective neurological symptoms	People with bilateral/quadrilateral neurological symptoms, including gait disturbance and coordination issues/bladder and bowel disturbance

Abbreviation: MSCC, metastatic spinal cord compression.

TABLE 10

## SIGNS OF SPINAL FRACTURE

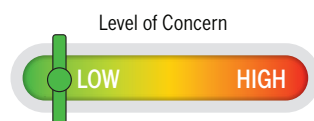
Signs (objective)/ Level of Evidence	Context	Physical Assessment	Low Clinical Suspicion	High Clinical Suspicion
Spine tenderness Low	Patients with midline bony tenderness should be considered to be at risk of spinal fracture <sup>50</sup>	Palpate the spinous processes and consider percussion/vibration with a 128-Hz tuning fork to examine spinal tenderness or reproduction of symptoms further Bony percussion/use of a tuning fork may indicate the presence of bony injury, though this should be interpreted with caution	No spinal tenderness	Tenderness or reproduction of symptoms on palpation, percussion, and/or vibration
Neurological signs Low	People with a subjective complaint of neurological symptoms must have a full neurological examination	Upper- and lower-limb neurology and upper and lower motor neuron testing should be performed. Neurological examination may need to include the upper and/or lower limbs, including upper and lower motor neuron clinical tests	Localized spinal pain with no distal referral or limb symptoms	People with spinal fracture and symptoms in the limbs, or with coordination/gait disturbance, or changes to bladder/bowel activity
Spinal deformity Low	Onset of deformity post trauma Sudden change in posture associated with a sudden increase in pain in the person with known osteoporosis	Bony percussion may indicate bony injury, as may use of a tuning fork, though these tests should be treated with some caution Imaging may be appropriate	No change in spinal posture	Sudden change in spinal shape related to trauma or in a known osteoporotic patient
Contusion or abrasion Low	May indicate the site of trauma and should be considered if associated with a painful site	...	Abrasion with no bony tenderness	Abrasion following trauma associated with central spinal bony tenderness



# POSITION STATEMENT

bag of concrete. The man has no previous history of fracture and is generally in good health. He smokes 5 cigarettes a day and has done so for 10 years. He has limited thoracic spine movement into rotation to both sides. He is locally tender to palpation at T8 and T9 unilaterally on both sides.

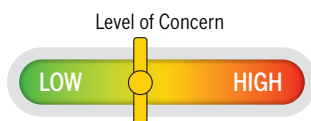
- Man under 65 years of age
- No family history
- No steroid use
- No previous fractures
- No excessive alcohol use
- Minimal to no smoking
- Clinical action: treat and monitor symptoms. His age and sex put him at low risk of osteoporotic fracture and his smoking habit is below 20 cigarettes per day, which is low risk. No further investigation is required at this stage



## Case 2

A 60-year-old woman presents with moderately severe thoracolumbar pain after bending over and lifting a heavy pot in the garden 3 weeks ago. Her pain is slightly improved. She is otherwise well and not on any medication other than paracetamol for her pain. She has no history of fracture. She had an early menopause at age 35. She smokes 20 cigarettes per day. She has pain in extension and rotation, some local spinal tenderness, and zygapophyseal (facet) joint tenderness bilaterally.

- Age and sex are risk factors (although she is under 65 years of age)
- Early menopause
- Smokes 20 cigarettes per day
- Clinical action: treat and monitor symptoms. While there are some risk factors, her symptoms are recent and improving, and she is on low-dose medication for pain. She does not require imaging, and it would be safe to treat her and monitor progress without further investigation at this stage

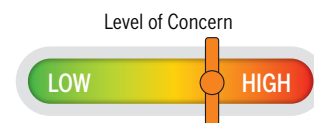


## Case 3

A 78-year-old woman presents with upper lumbar pain. No precipitating injury was reported, but the pain has worsened over the last 3 months. The pain is worse when lying supine. She has a history of left radius fractures. She had her menopause at age 38, having started her periods at 15 years of age. She is otherwise well and has no family history of osteoporosis.

- Age and sex are risk factors
- Worsening pain
- Early menopause and a late menarche
- Worse when lying supine
- History of fractures
- Clinical action: urgent thoracic spine X-ray. The patient has several risk factors for osteoporosis, including age, sex, early menopause and late menarche, and history of radius fractures. An X-ray of her thoracolumbar

region in the first instance would be appropriate



## Case 4

A 74-year-old man with mid-thoracic and lumbar pain presents with increasing pain locally in the spine, but no trauma/injury. Pain is worse in lying and standing and eased slightly in sitting. He is taking increasing doses and strengths of analgesia, which helps a little. He has some shortness of breath on exertion and pain on deep inspiration. He is a nonsmoker and drinks 3 pints of beer a day. He had a transurethral resection of the prostate for prostate cancer 10 years ago and has been discharged from follow-up by the urologist.

- Age and site of pain
- Worsening pain
- Increasing analgesia
- Alcohol intake
- History of prostate cancer
- Breathlessness
- Clinical action: urgent MRI of the whole spine. The man has several risk factors for spinal fracture. These include a history of prostate cancer, which is one of the cancers most likely to metastasize to the spine. His pain is worse in lying, which is more unusual and may indicate underlying serious pathology (tumor). His age puts him at risk of osteoporosis, even though he is male, as his bone density is likely to have decreased. His shortness of

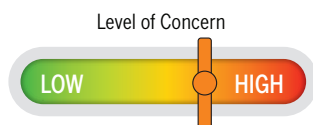
TABLE 11

INITIAL INVESTIGATIONS FOR SPINAL FRACTURE

Modality	Context
X-ray	X-rays are the first-line choice to determine whether there is a fracture present, with lateral views likely to yield the most information. <sup>50</sup> X-rays are readily available and relatively low cost. It may be difficult to determine the age of the fracture using X-rays alone
MRI	MRI is the investigation of choice for differentiating osteoporotic fractures from metastatic disease and myeloma. Use MRI if there are multiple fractures identified on X-ray. <sup>50</sup> MRI will also help to determine the age of the fracture, as it can identify bone marrow edema from recent/healing fractures <sup>51</sup>
CT scan	A CT scan is commonly performed for other conditions. Assess the sagittal view for undiagnosed vertebral fractures. <sup>72</sup> CT scans may be helpful in evaluating complex fractures or those with retropulsed fragments, as they give excellent bony definition. <sup>61</sup> CT scans may also be used where MRI is contraindicated

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging.

breath may be a concern in the absence of a chronic obstructive pulmonary disease or smoking history, given his prostate cancer. This man would benefit from further investigation of his spine with whole-spine MRI to exclude metastases and fracture. A chest X-ray would be appropriate to exclude lung metastases/disease, and blood tests would be relevant to exclude myeloma and look for signs of inflammation, infection, or increased bone turnover. If one is not able to request these medical tests, then urgent referral would be appropriate



**Suggested Pathway for Emergency/Urgent Referral** Refer to the clinical decision tool for suggested pathways for emergency/urgent referral (**FIGURE 3**).

### Spinal Malignancy

Metastases are cancer lesions that have spread from the primary cancer site to a new and different site in the body. Spinal malignancy (**TABLES 12 through 16**) refers to metastases that have spread specifically into the spine. Bone is a common site for metastases, known as metastatic bone disease (MBD), in a number of cancers (breast, prostate, lung, kidney, and thyroid).<sup>78</sup> A Cochrane review<sup>34</sup> was the key source paper used to formulate the international consensus questionnaire for the spinal malignancy section (**APPENDIX B**).

**Epidemiology** Estimates for the point prevalence of spinal malignancy as a cause of LBP range between 0.0% and 0.7% in the primary care setting,<sup>15,16,19,26,35,43</sup> 0.1% in the emergency care setting,<sup>68</sup> and 1.6% in the tertiary care setting.<sup>66</sup> Malignancy as a cause of musculoskeletal pain is estimated at 7.0% in the secondary care setting.<sup>40</sup>

**Risk Factors** The second most common serious pathology to affect the spine, after fracture, is MBD as a consequence of a primary cancer.<sup>20</sup> More effective medical treatment of primary cancers means people are living longer, putting them at greater risk of later developing MBD.<sup>7</sup> Cancer can affect all ages, but the risk of developing malignancy increases with age.<sup>33</sup> The consequences of untreated or late diagnosis are widespread metastases and visceral involvement. Metastatic bone disease can lead to significant morbidity and reduction in quality of life due to MSCC and, in the worst-case scenario, to paralysis and compromise of the bladder, bowel, and sexual function.<sup>78</sup>

**Clinical Picture** The spine is one of the earliest sites affected by MBD, especially in those cancers that have a propensity to metastasize.<sup>74</sup> The 5 most common cancers to metastasize are breast, prostate, lung, kidney, and thyroid.<sup>10</sup> Approximately 30% of all people with one of these primary diagnoses of cancer will have their cancer metastasize, so it is important not to subject all people with a history of cancer to unnecessary and worrying investigations. In breast cancer, MBD can occur at any time, with 50% occurring within the first 5 years after a primary diagnosis of cancer and the other 50% developing 10 years and later.<sup>44</sup>

Other primary cancers may metastasize, but have a lower incidence.<sup>62</sup> Clinicians should not be reassured by the

**TABLE 12**

### NUMBER OF SPINAL MALIGNANCY RED FLAGS GAINING CONSENSUS

#### Number of Red Flags

Questionnaire sent to 28 international experts	29 items reviewed <ul style="list-style-type: none"> <li>• 14 items reached consensus as appropriate</li> <li>• 6 items reached consensus as inappropriate</li> <li>• 9 items had no consensus</li> </ul>
Steering committee reviewed results	14 items included in the framework ( <b>TABLES 13 through 16</b> ) 12 items excluded ( <b>APPENDIX C</b> )

**TABLE 13**

### RISK FACTORS FOR SPINAL MALIGNANCY

Risk Factor/Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Past history of cancer High	Not all those cancers with a predilection to bone metastases will develop them. However, some will metastasize in the first 5 y of diagnosis, with 50% doing so 10-20 y later <sup>44</sup> Approximately 25% of people with MSCC have no known primary diagnosis <sup>57</sup>	Do you have any concerns about your symptoms? How long ago was the primary diagnosis made? How big was the primary tumor, and at which stage? Was there any lymph node involvement? Which treatment did you have?	Cancers with a predilection to bone metastases but in an early stage (1 or 2), with no lymph node involvement <sup>62</sup> Cancers that do not have a predilection to bone metastases (eg, ovarian cancer, melanoma <sup>62</sup> )	Cancers that have a predilection to bone metastases (eg, breast, prostate, lung, kidney, and thyroid <sup>60</sup> ) In breast cancer grade 3 or 4 (late stage), large tumors with lymph node involvement <sup>62</sup> In prostate cancer, a Gleason score of 9 or 10 (despite a PSA level greater than 50 ng/mL at diagnosis) is considered to be an aggressive cancer that is likely to spread more rapidly <sup>4</sup>

Abbreviations: MSCC, metastatic spinal cord compression; PSA, prostate-specific antigen.

TABLE 14

## SYMPTOMS OF SPINAL MALIGNANCY

Symptoms (subjective)/ Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Severe pain that may become progressive and constant Low	MBD does not have a linear progression and is more likely to wax and wane, but in the later stages it becomes more constant and progressive. People may report escalating pain, which can increase when lying flat <sup>79</sup>	Are your symptoms getting better, the same, or worse? Do you have band-like pain?	The person presents with initial severe pain but reports improvement with treatment; it is important to continue to evaluate, as the person may be in a good phase	Subjective reports of progressively worsening symptoms, with possible features of band-like pain, and inability to lie flat
Night pain Low	Most people with back pain will suffer from night pain. People who report being woken on movement and subsequently are unable to get comfortable and go back to sleep are of less concern than those who describe an inability to get back to sleep due to the intensity of symptoms and who report having to get up to relieve the pain <sup>25</sup>	Does your pain wake you at night? What do you have to do to get back to sleep? Does your night pain occur in a particular position?	The person reports that he or she is able to get back to sleep following a change of position or after taking medication	People who report having to walk the floors or sit in a chair or lie on the floor, with minimal relief
Systemically unwell Low	These are often symptoms described in the late stages of the disease and may include fatigue, nausea, anorexia, and constipation, which are symptoms suggestive of hypercalcemia <sup>24</sup> Constipation is not necessarily a systemic complaint These could appear on their own or as a cluster of symptoms	Do you feel well? • If not, then explore the features of hypercalcemia • Establish whether these symptoms could be associated with other causes	Able to associate with another cause	May describe the features of hypercalcemia, such as fatigue, nausea, stomach pain, and fever. These also tend to be progressive in nature
Thoracic pain Low	The thoracic spine is the most common site of MBD It is important to note that MBD may not correspond to the sensory level of pain	Is the area sensitive to touch? Is it mechanical in presentation?	Appears mechanical, but caution needs to be applied here. Often, MBD gives the impression of being mechanical in nature, appearing to initially respond to treatment	May be painful on percussion over the area of pain. May not be a mechanical pain pattern
Neurological symptoms Low	MBD can cause neurological symptoms and in some cases cord compression, including UMN signs and CES	Do you have any pins and needles or numbness? Have you noticed any weakness in your legs? Ask CES questions (see the CES section for more detail)	No distally referred symptoms or subjective neurological symptoms	People with bilateral/quadrilateral neurological symptoms, including gait disturbance and coordination issues/bladder and bowel disturbance
Unexplained weight loss High	Consider other causes of weight loss, such as change in diet, increase in exercise, medication that increases levels of pain, or other morbidities such as hyperthyroidism or diabetes <sup>59</sup> Consider more than 5% of weight loss over a 6-mo period as significant and requiring further questioning to establish a cause <sup>59</sup>	Is your weight steady? • If the person answers that he or she has lost weight, ask if the person knows why he or she has lost weight Have you changed your diet? How much weight loss over the last 3-6 mo have you had?	Weight loss related to medication or change in diet, or weight loss has stabilized Can be attributed to other causes	The individual has lost 5%-10% of body weight over a 3- to 6-mo period <sup>59</sup>
Unfamiliar back pain Low	Some people may have a long history of back pain, so it is important to establish whether this is a new or different pain	Is this a familiar pain to you? Have you experienced back pain in the past? Does this feel familiar to you?	If this is a person's first episode of back pain, conservative management is the first course of action	Describes pain that is unfamiliar and possibly worsening

Abbreviations: CES, cauda equina syndrome; MBD, metastatic bone disease; UMN, upper motor neuron.

TABLE 15

## SIGNS OF SPINAL MALIGNANCY

Signs (objective)/ Level of Evidence	Context	Physical Assessment	Low Clinical Suspicion	High Clinical Suspicion
Altered sensation from trunk down Low	People might report altered sensation that is nondermatomal and describe strange feelings in the legs (often a vague and non-specific, difficult-to-describe sensation). People may report decreased mobility <sup>79</sup>	Neurological examination testing Sensation throughout the area described by the patient	Normal neurology and no objective change in sensation	Objective signs and reduced sensation
Neurological signs Low	People who present with a subjective complaint of neurological symptoms must have a full neurological examination	Neurological examination that may need to include the upper and/or lower limbs, including upper and lower motor neuron clinical tests	Localized spinal pain with no distal referral or limb symptoms	People with symptoms in the limbs and/or with coordination/gait disturbance, or changes to bladder/bowel activity
Spine tenderness Low	Sometimes, the spine can be tender on percussion. However, lack of tenderness does not rule out the possibility of metastases. It is important to percuss the whole spine, as the area of pain reported may not be the area of metastasis	The clinician should palpate the spinous processes and may use percussion/vibration with a 128-Hz tuning fork to further examine spinal tenderness or reproduction of symptoms	No tenderness on palpation or percussion/vibration	Tenderness or reproduction of symptoms on palpation or percussion/vibration

TABLE 16

## INITIAL INVESTIGATIONS FOR SPINAL MALIGNANCY

Modality	Context
MRI	MRI is the gold standard for diagnosing MBD <sup>78</sup> Because the sensory level does not always correspond to the level of metastases if MBD is suspected, MRI of the whole spine is required <sup>46</sup>
CT scan	If there are contraindications to MRI
Blood tests	There is no combination of inflammatory markers that can be used as a reliable rule-in or rule-out test strategy. The decision to test must be made in the context of other clinical findings <sup>84</sup>

*Abbreviations: CT, computed tomography; MBD, metastatic bone disease; MRI, magnetic resonance imaging.*

absence of a history of cancer, as MSCC can be the first sign of metastases in approximately 25% of people who do not have a primary diagnosis of cancer and are subsequently diagnosed with MSCC.<sup>57</sup> Metastatic spinal cord compression can occur as a consequence of MBD when there is pathological vertebral-body collapse or where direct tumor growth causes compression of the spinal cord, leading to irreversible neurological damage.<sup>46</sup>

A high index of suspicion, early diagnosis with referral for urgent investigation, and prompt treatment can result in better outcomes in terms of function and prognosis.<sup>79</sup> Careful questioning using good communication skills is essential in early identification. The use of credit card-size patient information handouts can aid in communication between cli-

nicians and patients (eg, [https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service\\_education\\_mscc-resources\\_red-flag-card.pdf](https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service_education_mscc-resources_red-flag-card.pdf)).

Metastases can affect any region of the spine, most commonly the thoracic spine (70%), but also the cervical spine (10%) and lumbar spine (20%).<sup>73</sup> Primary tumors that are at high risk of metastasizing are those that were large at diagnosis, diagnosed at a late stage of the disease (stage 3 or 4), or had lymph node involvement with radical treatment, including surgery, chemotherapy, and/or radiotherapy.<sup>62</sup>

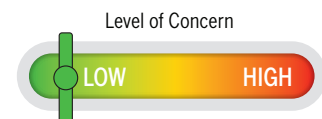
### Clinical-Reasoning Scenarios

#### Case 1

A 58-year-old woman with a 42-year history of chronic LBP and history of

breast cancer 5 years ago presents with an exacerbation of LBP. No other red flags or signs and symptoms suggestive of a mechanical problem are present on examination.

- History of breast cancer 5 years ago
- Clinical action: treat and monitor symptoms

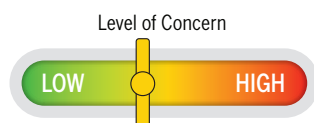


#### Case 2

The woman reports that her pain is not responding to usual medication and that she has been prescribed stronger medication, which is helping. She describes her symptoms as different from her usual back pain, which

has had some relief from conservative treatment.

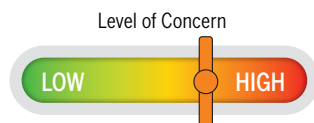
- History of breast cancer 5 years ago
- Using stronger painkillers
- Some relief with conservative management
- Describes unfamiliar pain
- Clinical action: treat, monitor symptoms, and discuss and document a clear strategy to follow if symptoms deteriorate (safety net)



## Case 3

The woman's pain has become progressively worse and she now complains of symptoms waking her at night. She is having difficulty getting back to sleep because the pain is so intense.

- History of breast cancer 5 years ago
- Using stronger painkillers
- Describes unfamiliar pain
- Night pain with worsening symptoms
- Clinical action: refer for urgent MRI, discuss and document a clear strategy to follow if symptoms deteriorate (safety net). Some concerning features suggest malignancy. An MRI scan of the whole spine should be carried out urgently



## Case 4

A 75-year-old man presents with a past history of prostate cancer 2 years ago, and he describes band-like pain and states that his legs feel odd and heavy. He reports occasionally tripping and stumbling. He says he has lost weight but has put it down to a loss of appetite due to the pain.

- History of prostate cancer
- Balance issues
- Odd sensations in legs
- Band-like pain
- Weight loss

- Clinical action: emergency MRI scan. Some concerning features may suggest MSCC. Provide information that describes the symptoms of MSCC and what to do if symptoms develop<sup>79</sup> (see also [https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service\\_education\\_mscc-resources\\_red-flag-card.pdf](https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service_education_mscc-resources_red-flag-card.pdf)).

Level of Concern



**Suggested Pathway for Emergency/Urgent Referral** Refer to the clinical decision tool for suggested pathways for emergency/urgent referral (**FIGURE 3**).

## Spinal Infection

Spinal infection is an infectious disease that affects the spinal structures, including the vertebrae, intervertebral discs, and adjacent paraspinal tissues.<sup>60</sup> In high-income and upper middle-income countries, spinal infection has steadily increased over recent years, possibly due to an aging population and an increase in intravenous drug abuse.<sup>52</sup> In lower middle-income and lower-income countries, spinal infection has increased due to the dual epidemic of HIV/AIDS and tuberculosis (TB).

For further country-specific information on TB, see [https://www.wvl.nhs.uk/library/general\\_docs/specialties/a\\_to\\_z/t/tb-service-who-estimates-of-tuberculosis-incidence-by-country.pdf](https://www.wvl.nhs.uk/library/general_docs/specialties/a_to_z/t/tb-service-who-estimates-of-tuberculosis-incidence-by-country.pdf),<sup>67</sup> and for further information on the global burden of the dual epidemic of HIV/AIDS

and TB, see the World Health Organization.<sup>87</sup> *Staphylococcus aureus* and *Brucella* are the other main bacteria that are identified in reports on spinal infection.<sup>88</sup>

Two key source papers were used to formulate the international consensus questionnaire for this section on spinal infection<sup>67,88</sup> (**APPENDIX B**). The questionnaire was sent to 21 international experts and contained 56 items (**TABLES 17 through 21**).

**Epidemiology** Spinal infections, such as TB, discitis, and spinal abscesses, are uncommon. The incidence is 0.2 to 2.4 cases per 100 000 annually in Western societies.<sup>9,30</sup> Spinal infection represents 2% to 7% of all musculoskeletal infections.<sup>45</sup> The point prevalence of spinal infection in developed countries is estimated at 0.0004% (across all settings).<sup>21</sup> The point prevalence of infection presenting as nonmechanical LBP is estimated at 0.01% in primary care<sup>41</sup> and 1.2% in a tertiary setting,<sup>66</sup> where post-procedural discitis represents up to 30% of all cases.<sup>21</sup>

Discitis mostly affects the lumbar spine (58%), followed by the thoracic spine (30%) and cervical spine (11%),<sup>30</sup> whereas TB lesions mainly affect the thoracic spine, and often at more than 2 levels.<sup>8</sup>

The frequency of spinal infections presenting in a clinical setting depends on the demographics of where you work. Due to the rarity of spinal infection in high-income countries, the diagnosis of spinal infection is often delayed, because clinicians fail to recognize the relevant red flags and consider spinal infection as a potential differential diagnosis.<sup>6</sup>

TABLE 17

## NUMBER OF SPINAL INFECTION RED FLAGS GAINING CONSENSUS

Number of Red Flags	
Questionnaire sent to 21 international experts	56 items reviewed <ul style="list-style-type: none"> <li>• 30 items reached consensus as appropriate</li> <li>• 0 items reached consensus as inappropriate</li> <li>• 26 items had no consensus</li> </ul>
Steering committee reviewed results	17 items included in the framework ( <b>TABLES 18 through 21</b> ) 24 items excluded ( <b>APPENDIX C</b> ) (16 items were combined)



TABLE 18

## RISK FACTORS FOR SPINAL INFECTION

Risk Factor/Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Immunosuppression Low	Comorbidities that cause immunosuppression can increase the risk of SI (eg, diabetes, HIV/AIDS, rheumatoid arthritis, pre-existing infections, alcohol abuse, and long-term use of steroids)	Do you have any health issues I need to be aware of? Is your diabetes well controlled? How long have you been taking steroid medication? Have you had a recent infection? Do you drink alcohol? • How many units a week do you drink?	Well-controlled comorbidities with no history of infections attributed to their condition	Uncontrolled morbidities with previous evidence of infections
Surgery: invasive Low	Long duration of surgery, in particular, the type of surgery (more commonly, lumbar and posterior approaches), and multiple revisions are significant risk factors for SI <sup>45</sup>	Any previous spinal or abdominal surgery?	No previous surgical intervention	The person has undergone surgery, particularly of the spine, with repeated revisions
Intravenous drug use Low	An increase in IVDA is thought to be associated with increased risk of SI <sup>49</sup> People with a history of intravenous drug use may present late and may not see the relevance of drug use to their condition. Know the incidence of drug abuse in the community within which you work	Questions must be in the context of the suspicion of SI I want to make sure you do not have an infection, so I am going to ask you some questions that will help me. Do you take, or have you ever taken, recreational drugs? • If yes, how were these drugs administered (orally or intravenously)?	No evidence of IVDA	Known intravenous drug user
Social and environmental factors (eg, migrant, occupational exposure, homelessness, prisoner, contact with infected animals) Low	There is a strong association with social deprivation and TB. Consider a patient's social history and whether his or her situation might include the following: alcohol abuse, migrant, homelessness, and imprisonment. <sup>47</sup> Consider working and living conditions (eg, contact with TB-infected cattle) <sup>88</sup>	What are the conditions like where you live, in the workplace, or places you frequently visit? Do you drink alcohol? • How many units a week do you drink?	Appears well kempt (well dressed with a clean and tidy appearance) and does not report social conditions that raise concern	Is unkempt (an untidy appearance and unwashed hair and clothes), raising concerns for poor living and social conditions
History of TB (born in TB-endemic country) Low	The majority of TB cases are a result of reactivation of latent infection acquired some years before <sup>47</sup> However, transmission of TB needs to be considered where individuals are born in TB-endemic countries or where an individual has been exposed to TB sufferers <sup>47</sup>	Have you ever been diagnosed with TB? • Where was the TB? Have you been abroad recently? • If yes, consider whether this country has a high burden of TB • If it is a country with high burden, has the person had an inoculation for TB? Have you been in contact with someone who has a history of TB?	No evidence of TB or contact with TB	No inoculation and has been exposed to TB via an endemic country or persons known to have TB
Recent pre-existing infection Low	New local back pain following a recent episode of sepsis or infection <sup>52</sup>	Have you recently had an infection? Consider other causes, such as urinary tract infections, and ask questions related to the condition	The person's infection has responded to treatment (eg, antibiotics) and back pain symptoms have improved	Progressively worsening symptoms

Abbreviations: IVDA, intravenous drug abuse; SI, spinal infection; TB, tuberculosis.

TABLE 19

SYMPTOMS OF SPINAL INFECTION

Symptoms (subjective)/ Level of Evidence	Context	Further Questions	Low Clinical Suspicion	High Clinical Suspicion
Spinal pain Low	Back pain is the most common presenting symptom. Neurological symptoms may be present. Usually, symptoms are nonspecific, with an insidious onset. Range of motion of the spine is often limited due to localized spinal pain and muscle spasm <sup>52</sup>	How did your back pain start? Are your symptoms getting better, worse, or remaining the same? Can you point to where your symptoms are?	No evidence of progressive symptoms and the person is not able to pinpoint symptoms	Localized progressive pain that limits movement significantly
Neurological symptoms Low	Neurological symptoms make up part of the classic triad for SI	Do you have any pins or needles or numbness? Have you noticed any weakness in your legs?	No distally referred symptoms or subjective neurological symptoms If the person does not describe any neurological symptoms, continue to evaluate for possible change	People with bilateral/quadrilateral neurological symptoms, including gait disturbance and coordination issues/bladder and bowel disturbance
Fatigue Low	People might describe "underperforming" activities that they would normally be able to carry out <sup>38</sup>	Do you feel fit and well? Have you noticed any changes in your ability to carry out activities that normally you manage easily?	No evidence of fatigue	Describes a level of fatigue that is abnormal for them when carrying out their usual tasks
Fever (consider sepsis/septic shock) Low	Fever makes up one of the classic triad symptoms. Recognize signs of sepsis, as it can develop rapidly <sup>71</sup> Fever can be absent in approximately 50% of people with SI <sup>88</sup>	Have you experienced a fever or chills since the onset of your back pain?	The absence of fever should not be reassuring; it should be monitored	Person reports fever within the time frame since onset of back pain. Concern that person might be developing sepsis
Unexplained weight loss Low	Consider other causes of weight loss, such as change in diet, increase in exercise or medication, increasing levels of pain, or other morbidities such as hyperthyroidism or diabetes <sup>59</sup> Consider more than a 5% weight loss over a 6-month period as significant; this requires further questioning to establish a cause <sup>59</sup>	Is your weight steady? • If the person answers that he or she has lost weight: - Do you know why you might have lost weight? - Have you changed your diet? - How much weight loss over the last 3-6 months have you had?	Weight loss related to medication or change in diet Weight loss has stabilized Can be attributed to other causes	Person has lost more than 5% of body weight over a 3- to 6-month period <sup>59</sup>

Abbreviation: SI, spinal infection.

**Clinical Picture** In cases of spinal infection, the time between onset and diagnosis is often prolonged. People can remain relatively healthy until symptoms manifest in the later stages of the disease.<sup>83</sup> Unlike malignancy, where symptoms wax and wane, spinal infection has a more linear progression, with back pain being the most common presenting symptom, which can progress to neurological symptoms. If not treated in a timely manner, the condition can progress with serious complications such as paralysis or instability of the spine, and can ultimately be fatal.

**Diagnosis** The subjective history should consider determinants that can be divided into comorbidities, environmental factors, and social factors. Comorbidities

that suppress a patient's immune system, such as diabetes, HIV, long-term steroid use, and smoking, put the person at risk of infection. Consider social and environmental factors like intravenous drug use, obesity, birth in a TB-endemic country, family history of TB, and living conditions (overcrowded living, homelessness, imprisonment, or rural environment). Spinal surgery is a key risk factor for spinal infection, in particular multiple revision surgery of the lumbar spine, with an added increased risk for obese people.<sup>88</sup>

The classic triad of clinical features comprises back pain, fever, and neurological dysfunction.<sup>14</sup> However, many people do not present with all 3 features. Only

50% of people report fever as a symptom.<sup>45</sup> Absence of fever cannot rule out spinal infection.

## Clinical-Reasoning Scenarios

### Case 1

A 47-year-old ex-heroin addict presents with recurrent episodes of LBP and a previous history of back pain. He describes symptoms that are intermittent. He is very inactive and usually self-treats the problem with rest.

- Male
- Ex-drug addict
- No other concerning features
- Clinical action: treat and monitor symptoms, discuss and document a clear strategy to follow if symptoms

TABLE 20

## SIGNS OF SPINAL INFECTION

Signs (objective)/ Level of Evidence	Context	Physical Assessment	Low Clinical Suspicion	High Clinical Suspicion
Neurological signs Low	People with a subjective complaint of neurological symptoms must have a full neurological examination	Neurological examination may need to include the upper and/or lower limbs, including upper and lower motor neuron clinical tests	Localized spinal pain with no distal referral or limb symptoms	People with symptoms in the limbs, or with coordination/gait disturbance, or with changes to bladder/bowel activity
Radiculopathy Low	SI can cause radiculopathy, which commonly presents with leg pain that usually radiates to the part of the body that is supplied by that specific nerve The person may present with weakness or pins and needles/humbleness	A full neurological examination, including dermatomes, myotomes, and reflexes	Normal neurological examination	Abnormal and progressing neurological deficit Management depends on the degree of neurological deficit (gross motor weakness of <3/5 or deteriorating neurology)
Spine tenderness on palpation Low	The spine can be tender and reproduce symptoms on percussion Lack of tenderness or reproduction of symptoms does not rule out SI Percuss the whole spine, as the area of pain reported may not be the area of infection	Palpate the spinous processes and consider using percussion/vibration with a 128-Hz tuning fork to further examine spinal tenderness or reproduction of symptoms Bony percussion/use of a tuning fork may indicate the presence of bony injury, but interpret with caution	No significant tenderness on palpation	Tenderness or reproduction of symptoms on palpation, percussion, and/or vibration

Abbreviation: SI, spinal infection.

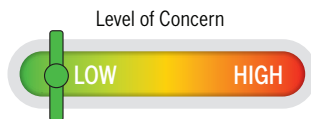
TABLE 21

## INITIAL INVESTIGATIONS FOR SPINAL INFECTION

Modality	Context
MRI	MRI is the imaging of choice. Findings on MRI can be observed 3-5 d after the onset of infection, with high sensitivity (96%), specificity (92%), and accuracy (94%) <sup>2,9,49,76</sup>
Blood tests	There is no single diagnostic blood test. Inflammatory markers are routinely used to assess for infection. The white blood cell count is less useful than erythrocyte sedimentation rate and C-reactive protein, as a normal white blood cell count does not exclude spinal infection <sup>45</sup>
X-ray	Chest X-ray if there is suspicion of tuberculosis

Abbreviation: MRI, magnetic resonance imaging.

deteriorate (safety net). Utilize a period of watchful waiting, with advice about being more physically active

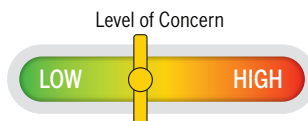


### Case 2

A 43-year-old man reports a 3-month history of LBP that is intermittent and mechanical in nature. He was born in Somalia and smokes 20 cigarettes per day. He is neurologically intact and exhibits normal function.

- Born in TB-endemic country
- Smoker

- Clinical action: treat and monitor symptoms, discuss and document a clear strategy to follow if symptoms deteriorate (safety net). Consider MRI if there is an increased suspicion of pathology

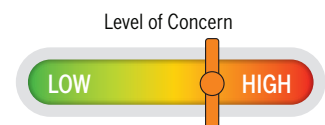


### Case 3

The man now feels unwell and has had a fever and chills in the last few days. He reports pain at night and is unable to settle. His pain has now become constant and more intense. Neurological assess-

ment is normal.

- Born in TB-endemic country
- Smoker
- Feels unwell
- Night pain, worsening symptoms
- Clinical action: urgent MRI and request blood tests, discuss and document a clear strategy to follow if symptoms deteriorate (safety net)



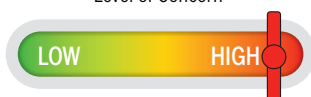
### Case 4

The man has now developed neurological signs and symptoms, with back and

left leg pain to the dorsum of the foot. He scored 3/5 (Oxford strength scale) for left dorsiflexion. He has been up all night with leg pain.

- Born in TB-endemic country
- Smoker
- Systemically unwell
- Night pain, worsening symptoms
- Neurological signs and symptoms
- Clinical action: emergency medical assessment is required. As per local pathway, consider/discuss whether hospital admission is required

Level of Concern



**Suggested Pathway for Emergency/Urgent Referral** Refer to the clinical decision tool for suggested pathways for emergency/urgent referral (FIGURE 3). ●

## STUDY DETAILS

**AUTHOR CONTRIBUTIONS:** All authors provided substantial intellectual content contributions to the conception and development of the framework document during early draft and revision stages. All authors provided final approval of the manuscript to be published and have agreed to be accountable for all aspects of the work to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

**DATA SHARING:** Data are from anonymous questionnaire responses and available on request from Dr Rachel Leech at R.Leech@mmu.ac.u. These data, with an appropriate citation, may be integrated with other datasets obtained from repositories, or other sources.

**PATIENT AND PUBLIC INVOLVEMENT:** Patient partners (n = 4) with previous scholarly review experience were identified through the Sussex MSK Partnership. Patient partners were engaged to participate in a web-based survey during phase 4 to provide opinions about the applicability, acceptability, and readability of the framework. Individual

perspectives about patient-provider communication in regard to red flag findings and opportunities for dissemination approaches to positively impact clinical practice were also provided. The steering committee reviewed all comments, and the red flag framework was modified accordingly.

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# [ POSITION STATEMENT ]

## APPENDIX A

### DEFINITIONS

- *Clinical risk/index of suspicion*: relates to clinical risk factors and presenting clinical features. Once the index of suspicion passes a critical threshold, the therapist will become concerned about the underlying cause of the person's complaint<sup>3</sup>
- *Emergency referral*: this needs to reflect local pathways, but, as a guide, on the same day
- *Experts by experience*: patient representatives
- *General practitioner review*: follow-up by medical practitioner; onward medical management to be carried out by the general practitioner
- *High level of evidence*: evidence supported by the literature
- *Investigations*: refers to requesting imaging or ordering blood tests to aid diagnosis
- *Low level of evidence*: evidence supported by consensus and the steering group
- *Red flag*: Goodman and Snyder<sup>2</sup> define red flags as features of the individual's medical history and clinical examination thought to be associated with a high risk of serious disorders such as infection, inflammation, cancer, or fracture. Red flags are clinical prediction guides—they are not diagnostic tests, and they are not necessarily predictors of diagnosis or prognosis. The main role of red flags is that, when combined, they help to raise the clinician's index of suspicion. Unfortunately, with a few exceptions, the prognostic strength of individual red flags or combinations of red flags is not known<sup>3</sup>
- *Safety netting*: safety netting is a management strategy used for people who may present with possible serious pathology. These strategies should include advice on which signs and symptoms to look out for, which action to take, and the time frame within which that action needs to be taken<sup>4</sup>
- *Shared decision making*: the conversation that happens between a patient and a clinician to reach a health care choice together
- *Urgent referral*: this needs to reflect local pathways, but, as a guide, within 5 days
- *Watchful waiting*: the act of close surveillance while undergoing treatment as required, but allowing time to pass before medical intervention or therapy is used<sup>1</sup>

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## APPENDIX B

### KEY PAPERS: EVIDENCE STATEMENTS

Pathology	Papers Reviewed, n	Patients, n	Evidence Statement
CES <sup>1</sup>	7	569	Red flags commonly used to screen for CES are not robust enough to diagnose CES on their own, as their diagnostic accuracy is poor. That being said, red flags still remain important clinical markers for the suspicion of CES, as presently they are the best tools that general health care practitioners have to screen for this serious condition
CES <sup>4</sup>	NA	NA	Policy document outlining best standards of care In patients with symptoms suggestive of CES, with confirmed cauda equina compression on MRI, the recommended treatment of choice is urgent surgical decompression Nothing is to be gained by delaying surgery, and potentially there is much to be lost. Decompressive surgery should be undertaken at the earliest opportunity, taking into consideration the duration of pre-existing symptoms and the potential for increased morbidity, while operating in the small hours. We do not consider that there is anything in the literature that justifies contravention of this principle. We recommend that reasons for any delay in surgery be documented
CES <sup>5</sup>	NA	NA	A number of authors, including Henschke et al, <sup>7</sup> Downie et al, <sup>2</sup> and Verhagen et al, <sup>12</sup> have published high-quality review papers demonstrating that red flags have a weak evidence base
Fracture <sup>13</sup>	8	7378	The available evidence does not support the use of many red flags to specifically screen for vertebral fracture in patients presenting with LBP. From the limited evidence, the findings give rise to a weak recommendation that a combination of a small subset of red flags may be useful to screen for vertebral fracture
Fracture <sup>11</sup>	NA	NA	NA
Fracture <sup>9</sup>	4 guidelines	NA	Overall, none of the guidelines was of satisfactory quality. The domains with the lowest scores were rigor of development and applicability
Fracture <sup>3</sup>	NA	NA	NA
Fracture <sup>8</sup>	NA	NA	Evidence rating: C—consensus, disease-oriented evidence, usual practice, expert opinion, or case series
Malignancy <sup>6</sup>	8	7361	For most “red flags,” there is insufficient evidence to provide recommendations regarding their diagnostic accuracy or usefulness for detecting spinal malignancy
Infection <sup>14</sup>	41	2058	The current evidence surrounding red flags for SI remains of low quality, and clinical features alone should not be relied on to identify SI
Infection <sup>10</sup>	NA	NA	NA

Abbreviations: CES, cauda equina syndrome; LBP, low back pain; MRI, magnetic resonance imaging; NA, not applicable; SI, spinal infection.

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## APPENDIX C

### RED FLAGS THAT GAINED CONSENSUS AS INAPPROPRIATE

Pathology	Risk Factors	Signs	Symptoms	Investigations
CES	...	<ul style="list-style-type: none"> <li>Absent bulbocavernosus reflex</li> </ul>	<ul style="list-style-type: none"> <li>Saddle anesthesia</li> </ul>	<ul style="list-style-type: none"> <li>X-ray</li> <li>Bladder ultrasound</li> </ul>
Fracture	<ul style="list-style-type: none"> <li>BMI, &lt;23 kg/m<sup>2</sup></li> <li>Recent back injury</li> <li>No regular exercise</li> <li>Family history of spinal fracture</li> <li>Smoking</li> <li>Alcohol intake, &gt;14 units/wk</li> </ul>	<ul style="list-style-type: none"> <li>Muscle spasm</li> </ul>	<ul style="list-style-type: none"> <li>Muscle spasm</li> <li>Leg pain</li> </ul>	...
Malignancy	<ul style="list-style-type: none"> <li>Failure to improve after 1 mo with conservative therapy</li> <li>Duration of episode, &gt;1 mo</li> <li>Age, &gt;50 y</li> </ul>	<ul style="list-style-type: none"> <li>Muscle spasm</li> <li>Fever recorded via thermometer (temperature, &gt;100°F/37.8°C)</li> </ul>	<ul style="list-style-type: none"> <li>Muscle spasm</li> <li>Insidious onset</li> <li>Patient reports symptoms of fever</li> <li>Patient reports neurological symptoms</li> <li>Patient reports having tried bed rest, with no relief</li> <li>Patient reports gradual onset before age 40</li> </ul>	<ul style="list-style-type: none"> <li>X-ray</li> </ul>
Infection	<ul style="list-style-type: none"> <li>Older age</li> <li>Spinal trauma</li> <li>Male sex</li> <li>Lives in rural area</li> <li>Ingestion of unpasteurized dairy product</li> <li>Blood pressure dysfunction</li> </ul>	<ul style="list-style-type: none"> <li>Abscess</li> <li>Paralysis</li> <li>Active bacterial/fungal infection</li> <li>Sepsis/septic shock</li> <li>Weight loss (at least 4 kg)</li> <li>Observed spinal deformity</li> <li>Anorexia (BMI, ≤19 kg/m<sup>2</sup>)</li> <li>Hepatosplenomegaly (liver and spleen enlargement)</li> </ul>	<ul style="list-style-type: none"> <li>Patient reports stiffness</li> <li>Patient reports feeling of tenderness</li> <li>Patient reports radiculopathy</li> <li>Patient reports bladder/bowel dysfunction</li> <li>Patient reports urinary incontinence</li> <li>Weakness/extreme weakness</li> <li>Arthralgia</li> <li>Myalgia</li> <li>Anorexia</li> </ul>	<ul style="list-style-type: none"> <li>CT scan</li> </ul>

Abbreviations: BMI, body mass index; CES, cauda equina syndrome; CT, computed tomography.